Statistical analysis of historic hydrocarbon production data from Gulf of Mexico oil and gas fields and application to dynamic capacity assessment in CO2 storage

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Abstract

Numerical modeling of CO_2 injection and reservoir flow is typically performed to forecast the number of wells, sustainable injection rates, and total storage volume (or mass). A critical determination for CO_2 storage in depleted oil and gas reservoirs is characterization of reservoir compartmentalization which informs boundary conditions in simulating injection scenarios. Constraining boundary conditions during CO_2 injection into geological formations is a key factor for feasible deployment project. Production history data from 616 wells in 100 oil and gas fields from Gulf of Mexico (GOM) offshore basin can be used to evaluate boundary conditions and total production (oil and gas) and therefor constrain the capacity for potential carbon storage. In general, the combination of decline curve analysis and statistical analysis (to specify constraining boundary conditions) allows the determination of the range of reservoir performance if existing inactive production wells in GOM area of study are used reversibly for CO_2 injection.

To constrain the mass of CO_2 which can be injected, it is useful to consider estimates of cumulative bulk (hydrocarbon + brine) production (CBP), which can be converted to equivalent CO_2 mass considering reservoir conditions. Summary CBP statistics are presented as a probability of non-exceedance (PNE), providing a forecast of likely injection rates and masses for other located CO_2 storage projects with similar geology and boundary conditions in the future. The 50% PNE for Equivalent CO_2 is a novel quantitative approach to investigate the possible injection capacity in CO_2 storage projects. The PNE sensitivity analysis shows that reservoir age, drive mechanism, reservoir trap, and reservoir porosity are the key controlling parameters for productivity and consequently optimum CO_2 storage capacity. Another key finding is the negligible correlation between CBP with reservoir transmissivity and porosity, which implies that other factors than just petrophysical parameters should be studied as constraining factors for CO_2 storage statistical analysis.